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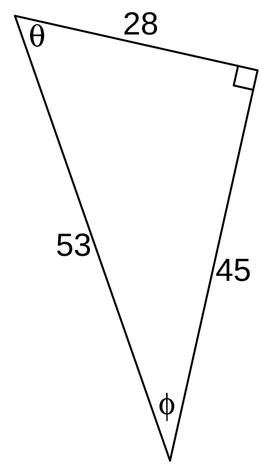
Question 1

Consider the right triangle below, with side lengths 28, 45, and 53 and acute angle measures θ and ϕ.

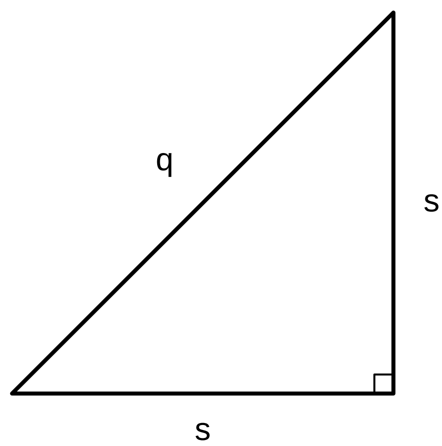


Express the 6 trigonometric ratios of angle θ. Write each ratio as a fraction. When relevant, use an improper fraction (like $\frac{5}{3}$), not a mixed number (not like $1 + \frac{2}{3}$).

Trig function	Ratio (function's output)
$\sin(\theta)$ =	45/53
$\cos(\theta)$ =	28/53
$\tan(\theta)$ =	45/28
$\csc(\theta)$ =	53/45
$\sec(\theta)$ =	53/28
$\cot(\theta)$ =	28/45

Question 2

Consider the isosceles right triangle below.



Prove that $q = s\sqrt{2}$.

(Remember Pythagorean Theorem: a triangle with lengths a, b, and c, where $a \leq b < c$, is a right triangle if and only if $a^2 + b^2 = c^2$.)

Substitute into Pythagorean equation:

$$s^2 + s^2 = q^2$$

Combine similar terms.

$$2s^2 = q^2$$

Take the square root of both sides.

$$\sqrt{2s^2} = \sqrt{q^2}$$

Distribute the radical over the product.

$$\sqrt{2} \cdot \sqrt{s^2} = \sqrt{q^2}$$

Both s and q are positive, so the square root is the inverse of the squaring. Simplify.

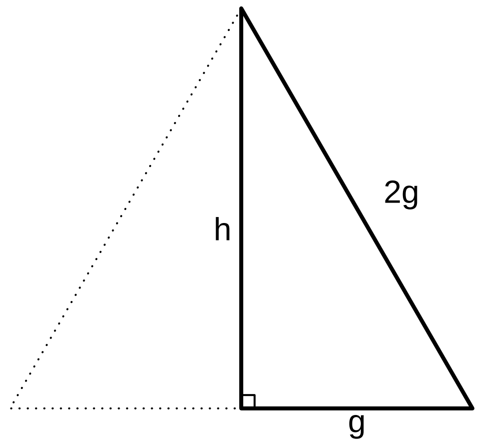
$$\sqrt{2} \cdot s = q$$

Rearrange.

$$q = s\sqrt{2}$$

Question 3

Consider the triangle below, generated by bisecting an equilateral triangle.



Prove that $h = g\sqrt{3}$.

(Remember Pythagorean Theorem: a triangle with lengths a, b, and c, where $a \leq b < c$, is a right triangle if and only if $a^2 + b^2 = c^2$.)

Substitute into Pythagorean equation:

$$g^2 + h^2 = (2g)^2$$

Distribute the exponent over the product.

$$g^2 + h^2 = 4g^2$$

Subtract g^2 from both sides.

$$h^2 = 3g^2$$

Take the square root of both sides.

$$\sqrt{h^2} = \sqrt{3g^2}$$

Distribute the radical across the product.

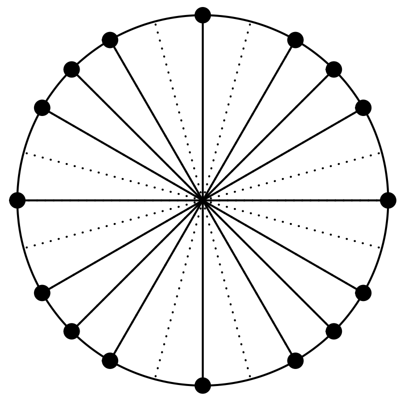
$$\sqrt{h^2} = \sqrt{3} \cdot \sqrt{g^2}$$

Both h and g are positive, so squaring and rooting undo each other. Also, multiplication is commutative.

$$h = g\sqrt{3}$$

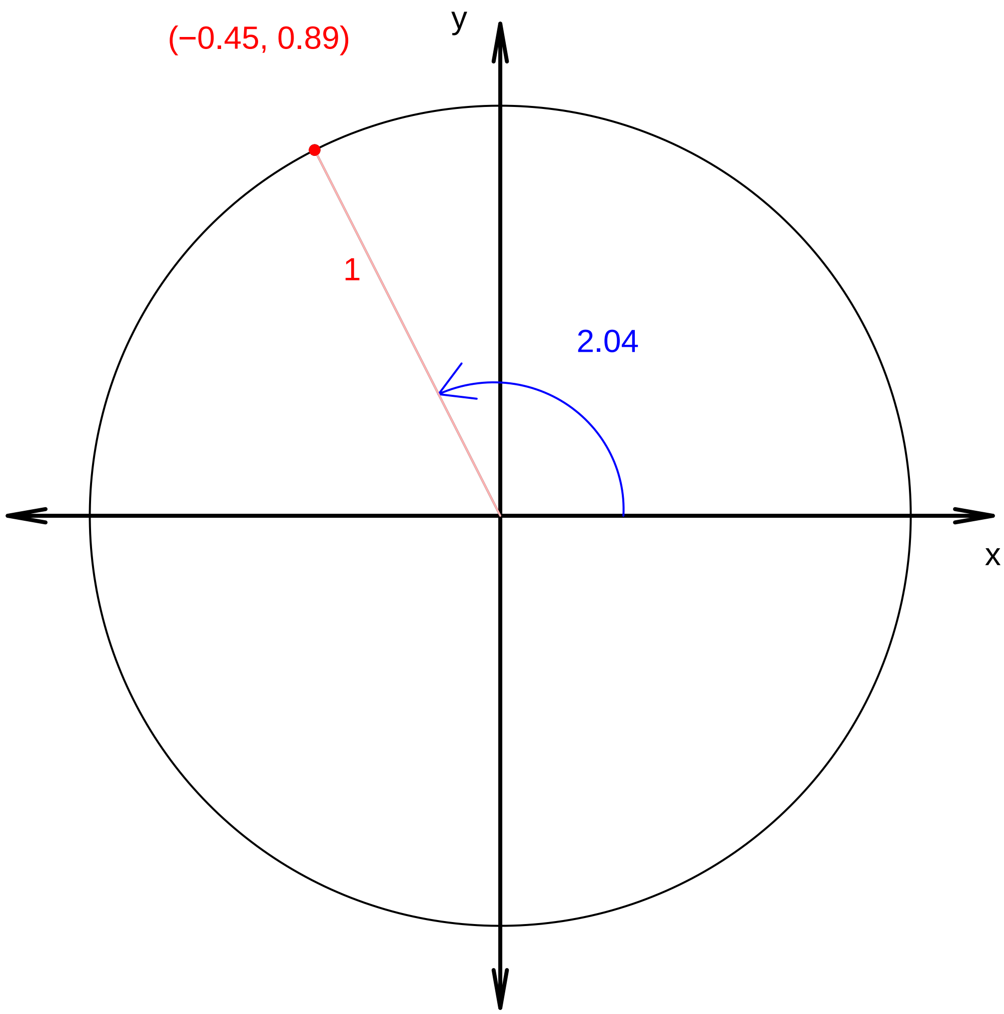
Question 4

A unit circle (with radius = 1) is drawn with its center at the origin. Based on the two proofs in Question 2 and Question 3, determine the angles and (exact) coordinates of the indicated 16 points, with the angle measure increasing, starting at 0, and all angles in standard position. All angles are multiples of 1/24 of a revolution.



Angle measure (degrees)	Angle measure (radians)	x	y
0°	0	1	0
30°	$\frac{2\pi}{12} = \pi/6$	$\sqrt{3}/2$	$1/2$
45°	$\frac{3\pi}{12} = \pi/4$	$\sqrt{2}/2$	$\sqrt{2}/2$
60°	$\frac{4\pi}{12} = \pi/3$	$1/2$	$\sqrt{3}/2$
90°	$\frac{6\pi}{12} = \pi/2$	0	1
120°	$\frac{8\pi}{12} = 2\pi/3$	$-1/2$	$\sqrt{3}/2$
135°	$\frac{9\pi}{12} = 3\pi/4$	$-\sqrt{2}/2$	$\sqrt{2}/2$
150°	$\frac{10\pi}{12} = 5\pi/6$	$-\sqrt{3}/2$	$1/2$
180°	$\frac{12\pi}{12} = \pi$	-1	0
210°	$\frac{14\pi}{12} = 7\pi/6$	$-\sqrt{3}/2$	$-1/2$
225°	$\frac{15\pi}{12} = 5\pi/4$	$-\sqrt{2}/2$	$-\sqrt{2}/2$
240°	$\frac{16\pi}{12} = 4\pi/3$	$-1/2$	$-\sqrt{3}/2$
270°	$\frac{18\pi}{12} = 3\pi/2$	0	-1
300°	$\frac{20\pi}{12} = 5\pi/3$	$1/2$	$-\sqrt{3}/2$
315°	$\frac{21\pi}{12} = 7\pi/4$	$\sqrt{2}/2$	$-\sqrt{2}/2$
330°	$\frac{22\pi}{12} = 11\pi/6$	$\sqrt{3}/2$	$-1/2$

Question 5



An angle of 2.04 radians intersects the unit circle at coordinates $(-0.45,\ 0.89)$. Fill the blanks in the two equations below.

$$\sin\left(\boxed{2.04}\right) = \boxed{0.89}$$

$$\cos\left(\boxed{2.04}\right) = \boxed{-0.45}$$

$$\tan\left(\boxed{2.04}\right) = \frac{\boxed{0.89}}{\boxed{-0.45}}$$